PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G10H 7/00, 1/00

A1

(11) International Publication Number: WO 00/17852

(43) International Publication Date: 30 March 2000 (30.03.00)

(21) International Application Number: PCT/KR99/00574

(22) International Filing Date: 22 September 1999 (22.09.99)

(30) Priority Data:
1998/18121 U 23 September 1998 (23.09.98) KR
1999/33652 16 August 1999 (16.08.99) KR

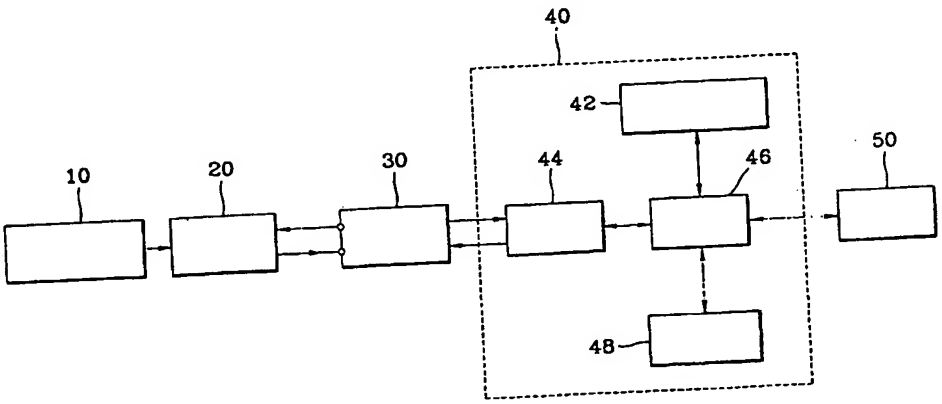
(71)(72) Applicant and Inventor: LEE, Moon, Key [KR/KR]; 6–309 Misung Apt., Bulkwang–dong, Eunpyeong–gu, Seoul 122–040 (KR).

(74) Agent: LEE, Young, Pil; The Cheonghwa Building, 1571–18 Seocho–dong, Seocho–gu, Seoul 137–073 (KR).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: ELECTRONIC MUSICAL INSTRUMENT USED IN CONNECTION WITH COMPUTER



(57) Abstract

An electronic musical instrument used in connection with a computer (40). The electronic musical instrument includes: a key input portion (10) for inputting r*c keys relating to generation or adjustment of musical sounds; a speaker (50) for outputting sound corresponding to the key input by the key input portion, to the outside; a circuit portion (20) for selectively outputting keys input by the key input portion; and a computer for storing data of the instrumental sound corresponding each of r*c keys, continuously outputting test values corresponding to the data of the instrumental sound through the output terminal of a parallel port to the circuit portion, to check which key is depressed by a user, converting data of the instrument sound which corresponds to the depressed key, into an analog signal through a sound card (42), and outputting the analog signal to the speaker. Therefore, because the electronic musical instrument generates sound using a sound card installed in the computer, the musical instrument can be implemented at low cost by using the popularized computer. Also, a program capable of detecting keys depressed and of generating sound can be upgraded, so that the function of program can be diversified and the user can choose the program he likes, and because the keyboard including the key input portion and the circuit portion can be detached from the parallel port (30) when there is no need to use the musical instrument, so that the space occupied by the instrument can be reduced compared to a digital piano.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Larvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

ELECTRONIC MUSICAL INSTRUMENT USED IN CONNECTION WITH COMPUTER

Technical Field

The present invention relates to electronic musical instrument, and more particularly, to electronic musical instrument used in connection with a computer, in which a key input portion which is used to input musical sounds, is connected to a parallel port of the computer.

Background Art

In general, conventional electronic musical instruments, for example, an electronic keyboard, generates sounds by using a central processing unit (CPU) installed in the instrument itself. Thus, the musical instrument occupies a large amount of space and is costly. Also, because the CPU cannot be upgraded, the kinds of sounds that can be generated thereby are limited.

Disclosure of the Invention

To solve the problem, it is an object of the present invention to provide an electronic musical instrument used in connection with a computer, in which instrumental sounds are generated by connecting a key input portion which is used to input instrumental sounds, to a parallel port of the computer.

To achieve the object, there is provided an electronic musical instrument used in connection with a computer, comprising: a key input portion for inputting r×c keys relating to generation or adjustment of musical sounds; a speaker for outputting sound corresponding to the key input by the key input portion, to the outside; a circuit portion for selectively outputting keys input by the key input portion; and a computer for storing data of the instrumental sound corresponding each of r×c keys, continuously outputting test values corresponding to the data of the instrumental sound through the output terminal of a parallel port to the circuit portion, to check which key is

depressed by a user, converting data of the instrument sound which corresponds to the depressed key, into an analog signal through a sound card, and outputting the analog signal to the speaker.

Brief Description of the Drawings

FIG. 1 is a block diagram of an electronic musical instrument used in connection with a computer according to a preferred embodiment of the present invention;

FIG. 2 is a detailed diagram showing the structure of the circuit portion of FIG. 1;

FIG. 3 is a detailed circuit diagram of the 32×10 switch array shown in FIG. 2;

FIG. 4A is a detailed circuit diagram of an example of the column of switches indicated by dashed lines in FIG. 3;

FIG. 4B is a detailed circuit diagram of another example of the column of switch indicated by dashed lines in FIG. 3;

FIG. 5 is a detailed circuit diagram of the portion indicated by the circled portion in FIG. 4A; and

FIG. 6 is a flowchart illustrating a key checking program stored in the program storing portion of FIG. 1.

Best mode for carrying out the Invention

Referring to FIG. 1, an electronic musical instrument used in connection with a computer according to a preferred embodiment of the present invention, comprises a key input portion 10, a circuit portion 20, a computer 40 and a speaker 50. The circuit portion 20 and the computer 40 are connected by a parallel port 30. The parallel port 30 has an output terminal Pout from the computer 40 and an input terminal Pin to the computer 40. The parallel port 30 is generally attached to the case of the computer 40.

The key input portion 10 allows a user to input r×c keys which generate instrumental sounds. The key input portion 10 may have a similar

shape to other musical instrument. However, the shape of the key input portion 10 can be varied. The circuit portion 20 selects keys input by the key input portion 10 and outputs signals corresponding to the selected keys to the input terminal Pin of the parallel port 30. The speaker 50 outputs instrumental sounds corresponding to the input keys.

The computer 40 stores data of instrumental sounds corresponding to each of r×c keys in a program storing portion 48 and continuously outputs test values corresponding to data of instrumental sounds through the output terminal Pout of the parallel port 30 to the circuit portion 20, to check which key is depressed by a user. Here, the program stored in the program storing portion 38 can manage sound data by itself and generate sounds using a sound chip provided by a sound card 42. Also, data of instrumental sounds corresponding to the key depressed by the user, which has been identified by the computer 40, is input through the input terminal Pin of the parallel port 30 and then an interface (I/F) 44 to a central processing unit (CPU) 46. When the CPU 46 reads the corresponding data of instrumental sound using the program stored in the program storing portion 48 and sends the data to a sound card 43, the sound card 42 converts the input signal into an analog signal and outputs the analog signal to the speaker 50. Alternatively, the sound can be generated using a musical instrument digital interface (MIDI) output function provided by the sound card 42. In this case, the CPU 46 sends MIDI message about the kind of instrument, pitch and volume to the sound card through MIDI and sounds of the corresponding instrument are generated by the sound card 42.

Here, the test value refers to address of switch array which is output to the circuit portion 20 in order to check which key of the key input portion 10 is depressed by the user, and is programed with respect to all instrumental sounds corresponding to each row and column.

The key checking program will be described in detail with reference to FIG. 6. First, "r" is set to zero (step 602) and "c" is set to zero (step 604). The "r" and "c" values are output through the output port Pout of the parallel port 30 to the circuit portion 20. The value set by the circuit portion 20 is

read through the input pin Pin (step 608). Then, a determination as to whether a (r, c) key is depressed, is made using the read value (step 610). If a (r, c) key is depressed, the sound card 42 generates a sound corresponding to the (r, c) key and outputs the sound to the speaker 50 (step 612).

In step 614, It is determined whether a user has stopped using the program. If the user has not terminated use of the program, step 616 sets "c" to c+1. In step 618, it is determined that "c" is less than 10, the process moves to the step 606. These steps are repeated until "c" reaches 10. If "c" is equal to 10, "r" is set to r+1 (step 620). Then, a determination of whether "r" is less than 32, is made (step 622). If "r" is less than 32, the process moves to the step 604. These steps are repeated until "r" equals 32.

That is, a determination as to whether a key is depressed or not, is made on all keys corresponding to cells from (0, 0) to (31, 9). In this embodiment, a key input portion having 32×10 keys is illustrated. However, the present invention is not limited to such a key input portion. Theoretically, the maximum multiplexer capable of being implemented with 8 bits is 255×1. The above described key checking program is stored in a memory of a computer system, so that it can be upgraded.

FIG. 2 is a detailed diagram of the structure of the circuit portion 20 shown in FIG. 1. In FIG. 2, assuming that the computer 40 outputs a 12-bit test value through the output terminal Pout of the parallel port 30 in order to check whether a (i, j) key of the key input portion 10 is depressed. A binary-coded decoder 202 converts 4 bits of a 12-bit test value, which are used to check whether jth column is depressed, into a decimal data value, and outputs a low voltage, for example, 0V, with respect to the jth column, and a high voltage, for example, 5V, with respect to the remaining columns, to a 32×10 switch array 204.

A 32×1 multiplexer (MUX) 206 receives 8 bits of the 12-bit test value output from the computer 40, selects the ith row signal of the jth column signal, and outputs the selected signal to the input terminal Pin of the

parallel port 30. That is, the 32×1 MUX 206 outputs a low voltage in the case where a (i, j) key of the key input portion 10 is depressed, and a high voltage in the case where the (i, j) key is not depressed, to the input port Pin of the parallel port 30. Because the computer 40 stores the number of bits of the test value with respect to each row at the initial state, when an input value to the input terminal Pin, among the values with respect to each switch of the corresponding column, is given, it can be noticed whether the corresponding key is depressed or not. Also, because data of instrumental sound are stored corresponding to the number of bits of the test value, a sound corresponding to the depressed key can be generated.

When a (i, j) key is input by the key input portion 10, the 32×10 switch array 204 transfers the low voltage with respect to the jth column, output from the binary-coded decimal decoder 202, to the 32×1 MUX 206. If a key is not depressed, a high voltage with respect to the remaining columns or a high voltage with respect to the ith row is transferred to the 32×1 MUX 206. Here, if none of the keys is depressed, a high voltage Vcc is transferred through a resistor to the 32×1 MUX 206.

Thus, because the computer 40 continuously checks which key is depressed, through the output terminal Pout of the parallel port 30, a key depressed by the user can be identified. A volume adjusting pedal 210 adjusts the volume of the instrumental sound by working the pedal. That is, when the user steps on a pedal deeply, the volume is higher, while when the user steps on the pedal slightly, the volume is lower. A variable resistor 212 outputs the resistance which varies according to the depth of pedaling of the volume adjusting pedal 210 to an analog-to-digital converter (ADC) 208. The ADC 208 converts the analog voltage from the variable resistor 212 to a digital value and inputs a digital value to the input terminal Pin of the parallel port 30.

A sustain pedal switch 212 is connected between the power voltage Vcc and ground, and inputs a value for adjusting echoing or no-echoing according to the use of a sustain pedal to the input terminal Pin of the parallel port 30. The function of the sustain pedal switch 214 can be varied

in a program by a user.

When a 5-bit input terminal Pin of the parallel port 30 is used, preferably, the signal selected by the 32×1 MUX 206, the sustain pedal signal, is 1 bit and the signal output from the ADC 208 is 3 bits. However, these values are merely illustrative and the number of bits can be varied.

FIG. 3 is a detailed circuit diagram of the 32×10 switch array 204 shown in FIG. 2. As shown in FIG. 3, the number of switches in the switch array 204 totals 320, and each switch is connected one-to-one to each diode shown in FIGs. 4A and 4B. FIG. 4A is a detailed circuit diagram of the column of switches indicated by a dashed line in FIG. 3. For convenience, FIG. 4A illustrates only one column and thus only 32 diodes are shown in FIG. 4A. Thus, the total number of diodes with respect to 10 columns is 320. Also, one end of each of the 32 diodes shown in FIG. 4A is connected to the binary-coded decimal decoder 202 and the other end thereof is connected to each switch. Thus, the corresponding diode is connected through a resistor to Vcc only when a user depresses a switch. Alternatively, the column of switches can be implemented as shown in FIG. 4B. That is, among 32 diodes arranged in a columnar (longitudinal) direction, neighboring two diodes are connected, so that the number of diodes connected to one end of the binary-coded decimal decoder 202 is reduced to 16. In detail, as shown in FIG. 4B, neighboring two diodes in a column direction and neighboring two switches in a row direction are integrated, respectively. That is, for example, diodes 0 and 1 are integrated to be diode 0, diodes 2 and 3 are integrated to be diode 1, and diodes 30 and 31 are integrated to be diode 15. Each integrated switch is located at portions indicated by the solid line when a user does not depress any key of the key input portion 10 (for example, a piano keyboard) connected to the switches. In this case, the even rows (switches), for example, 0th, 2th, ... 30th rows, are connected to the diodes. Meanwhile, when a user depresses a key of the key input portion 10, each integrated switch is located at portions indicated by dashed lines. That is, the odd rows, for example, 1st, 3rd, 5th, ... 31th rows, are connected to the diodes. Thus, when a user

quickly depresses a keyboard, the switches are shifted from the positions indicated by solid lines to the positions indicted by dashed lines within a short time. Meanwhile, when a user depresses a key of the keyboard slowly, such shifting of the switches occurs slowly. Also, the volume can be adjusted by measuring the shifting time using the program stored in the program storing portion.

FIG. 5 is a detailed circuit diagram of the circled portion in FIG. 4A. In FIG. 5, Sij indicates a (i, j) switch. When Sij is depressed, a low voltage of the jth row input from the binary-coded decimal decoder 202 is transferred to the 32×1 MUX 206. The 32×1 MUX 206 selects a low voltage of the Sij according to a row select signal (Sr), and the transferred low voltage, which is indicated by Sk in FIG. 3, to the input terminal Pin of the parallel port 30.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims. In the present invention, the sustain pedal portion and the volume adjustment pedal portion are implemented in the circuit portion. However, these portions can be implemented as keys of the key input portion if desired. Also, the key input portion can provide a function of recording and reproducing a musical performance, a function of adjusting volume and a function of serving accompaniment, other than the function of adjusting the pitch or of selecting types of musical instrument, according to the function of the program storing portion. That is, the key input portion can be implemented to provide various functions according to how the function of each key is programed.

Industrial Applicability

According to the present invention, the key input portion used to input instrumental sound is connected to the parallel port of a computer, to generate instrumental sound, thereby providing the following effects.

First, the electronic musical instrument according to the present

invention generates sound using a sound card installed in the computer whereas a conventional electric keyboard generates sound using a sound generating circuit installed therein, so that musical instrument can be implemented at low cost by using the popularized computer.

Second, the program capable of analyzing depression of keys and of generating sound can be upgraded easily, so that the function of program can be diversified and the user can choose the program he likes.

Third, because the keyboard including the key input portion and the circuit portion can be detached from the parallel port when there is no need to use the musical instrument, so that the space occupied by the instrument can be reduced compared to a conventional electronic keyboard.

Fourth, it is convenient to carry the electronic musical instrument, because it can be used in connection with a notebook or laptop computer.

What is claimed is:

1. An electronic musical instrument used in connection with a computer, comprising:

a key input portion for inputting r×c keys relating to generation or adjustment of musical sounds;

a speaker for outputting sound corresponding to the key input by the key input portion, to the outside;

a circuit portion for selectively outputting keys input by the key input portion; and

a computer for storing data of the instrumental sound corresponding each of r×c keys, continuously outputting test values corresponding to the data of the instrumental sound through the output terminal of a parallel port to the circuit portion, to check which key is depressed by a user, converting data of the instrument sound which corresponds to the depressed key, into an analog signal through a sound card, and outputting the analog signal to the speaker.

2. The electronic musical instrument of claim 1, further comprising at least one of a pedal for a general function, capable of changing the function of the electronic musical instrument using a program stored in the computer, a volume adjustment pedal for adjusting volume of sound, and a sustain pedal for adjusting echoing or no-echoing of sound.

3. The electronic musical instrument of claim 1, wherein the key input portion further comprises at least one of a pitch adjustment key, an instrument selection key, a performance recording/reproducing key, a volume adjustment key, an accompaniment key, and general function keys whose function can be changed by the program stored in the computer.

4. The electronic musical instrument of claim 1, wherein the computer outputs 12-bit test values through the output terminal of the parallel port in order to check whether a (i, j) key of the key input portion is

depressed, and

the circuit portion comprises:

a binary-coded decimal decoder for converting 4 bits of 12 bits of each test value output from the computer, which are used to check whether a key of the jth column is depressed, into a decimal data value, and outputting a low voltage to only the jth column and a high voltage to the remaining columns;

a switch array for outputting the low voltage of the jth column which are output by the binary-coded decimal decoder if the key of ith row and jth column is input by the key input portion;

a selector for selecting a signal of the ith row in the jth column according to 8 bits of 12 bits of each test value output from the computer, which are used to select a signal of the ith row, and outputting the selected signal to the input terminal of the parallel port;

a volume adjustment pedal portion for adjusting the volume of instrumental sound by working the pedal;

a variable resistor for outputting resistance which varies by the working of the volume adjustment pedal portion;

an analog-to-digital converter (ADC) for converting an analog voltage value from the variable resistor into a digital value and inputting the digital value to the input terminal of the parallel port; and

a sustain pedal portion coupled between power voltage (Vcc) and ground, for inputting a value which is used to adjust echoing or no-echoing of the sound according to the working of the sustain pedal, to the input terminal of the parallel port.

5. The electronic musical instrument of claim 4, wherein the switch array is a 32×10 array and the selector is a 32×1 multiplexer.

FIG. 1

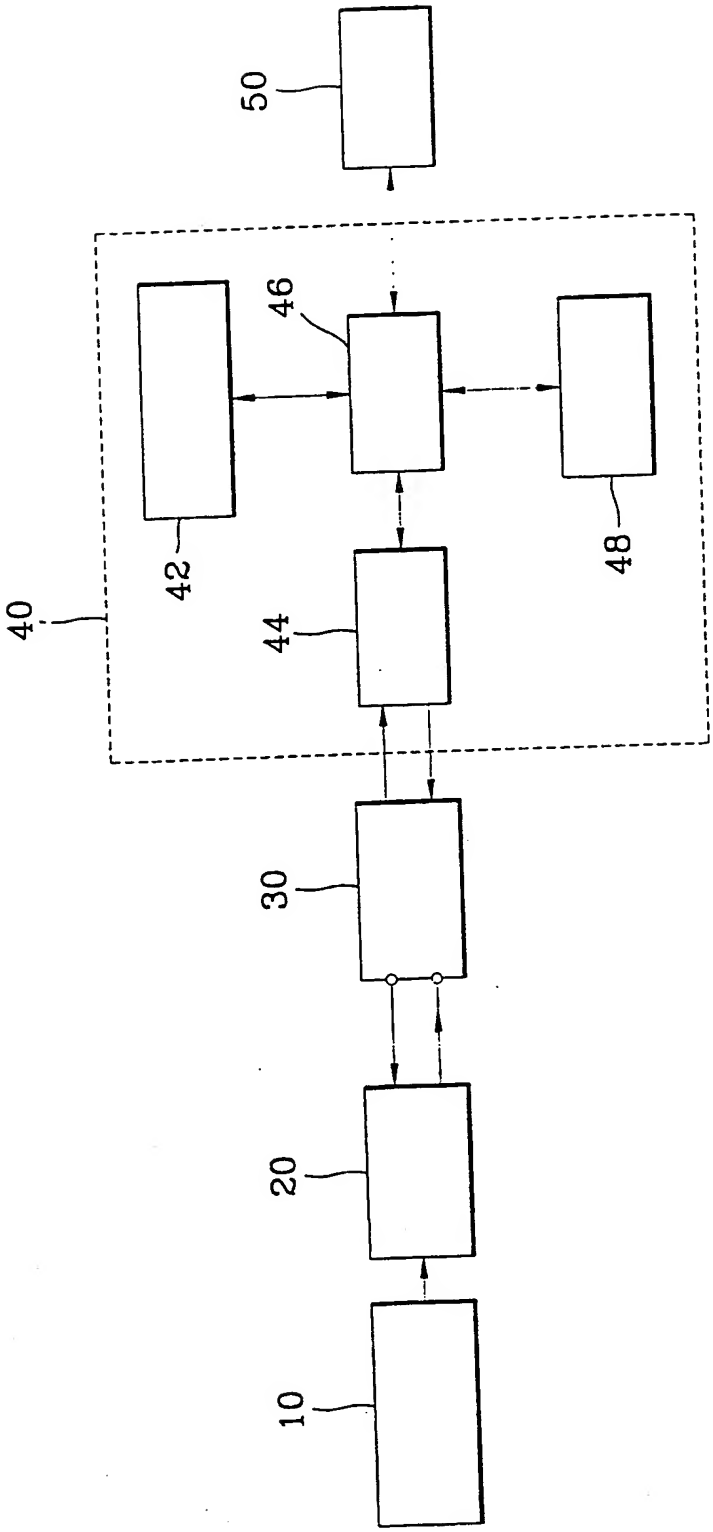


FIG. 2

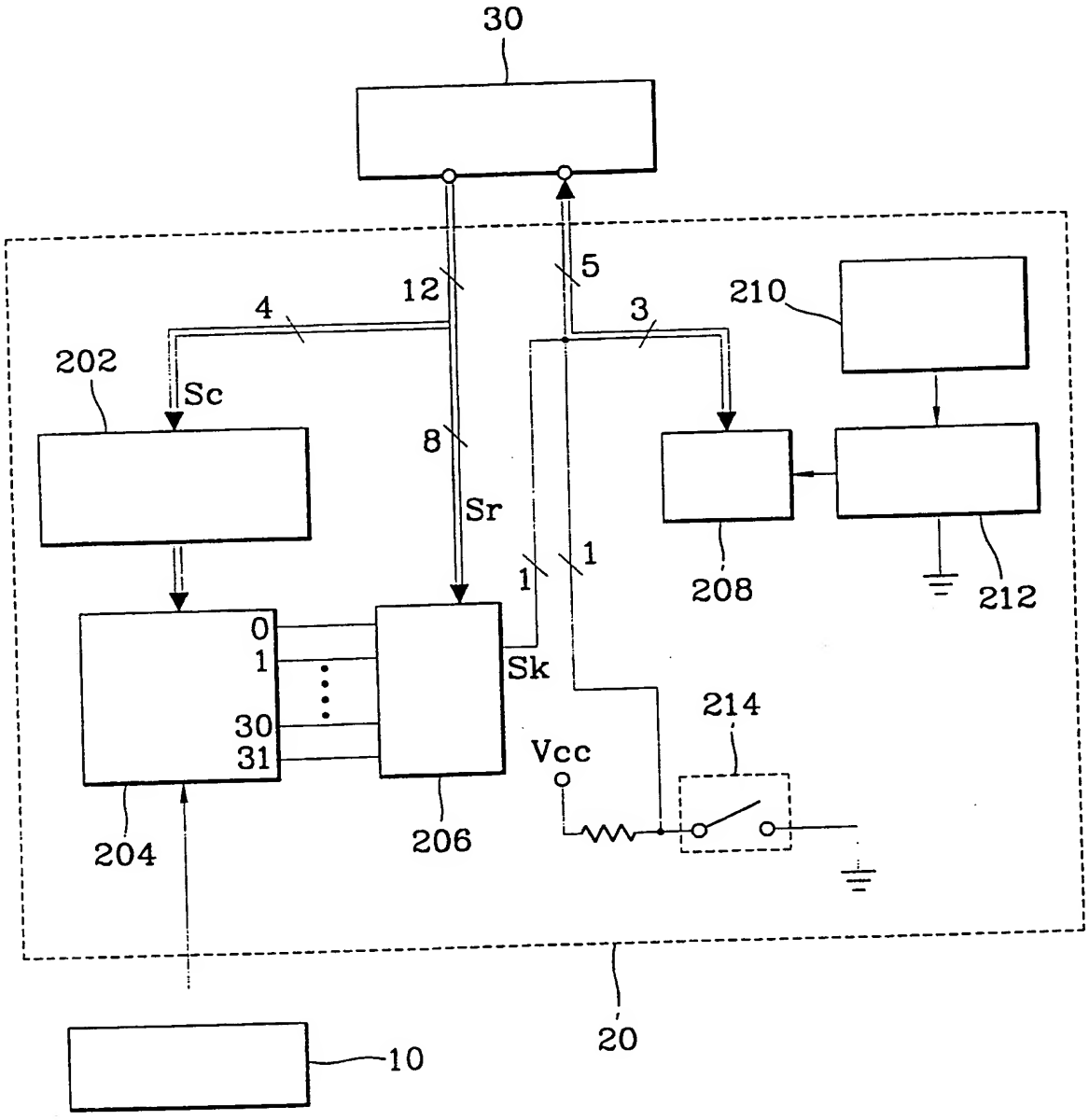

30
12
5
4
3
210
202
Sc
8
Sr
1
1
208
212
0
1
30
31
Sk
214
Vcc
204
206
20
10

FIG. 3

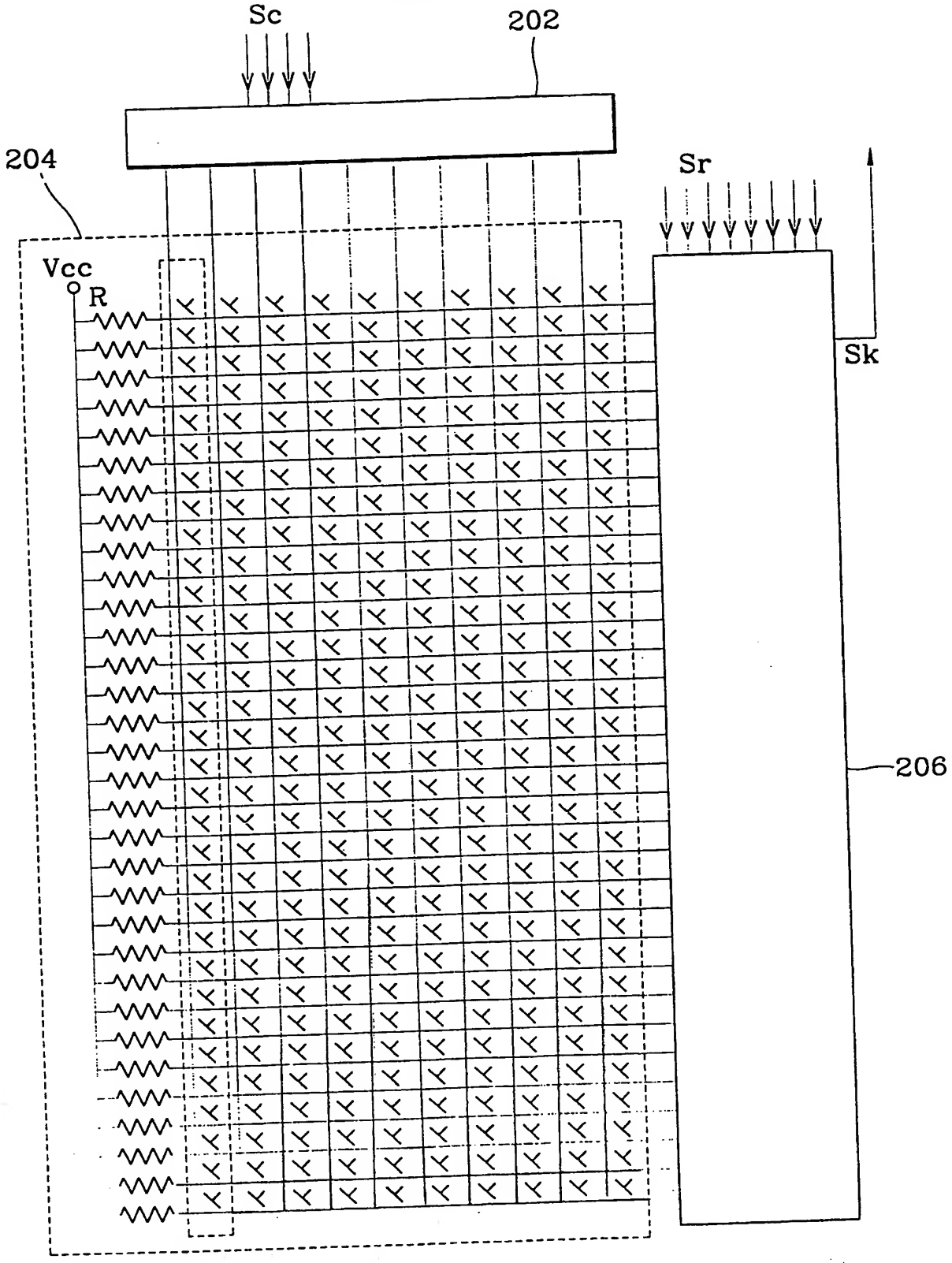


FIG. 4A

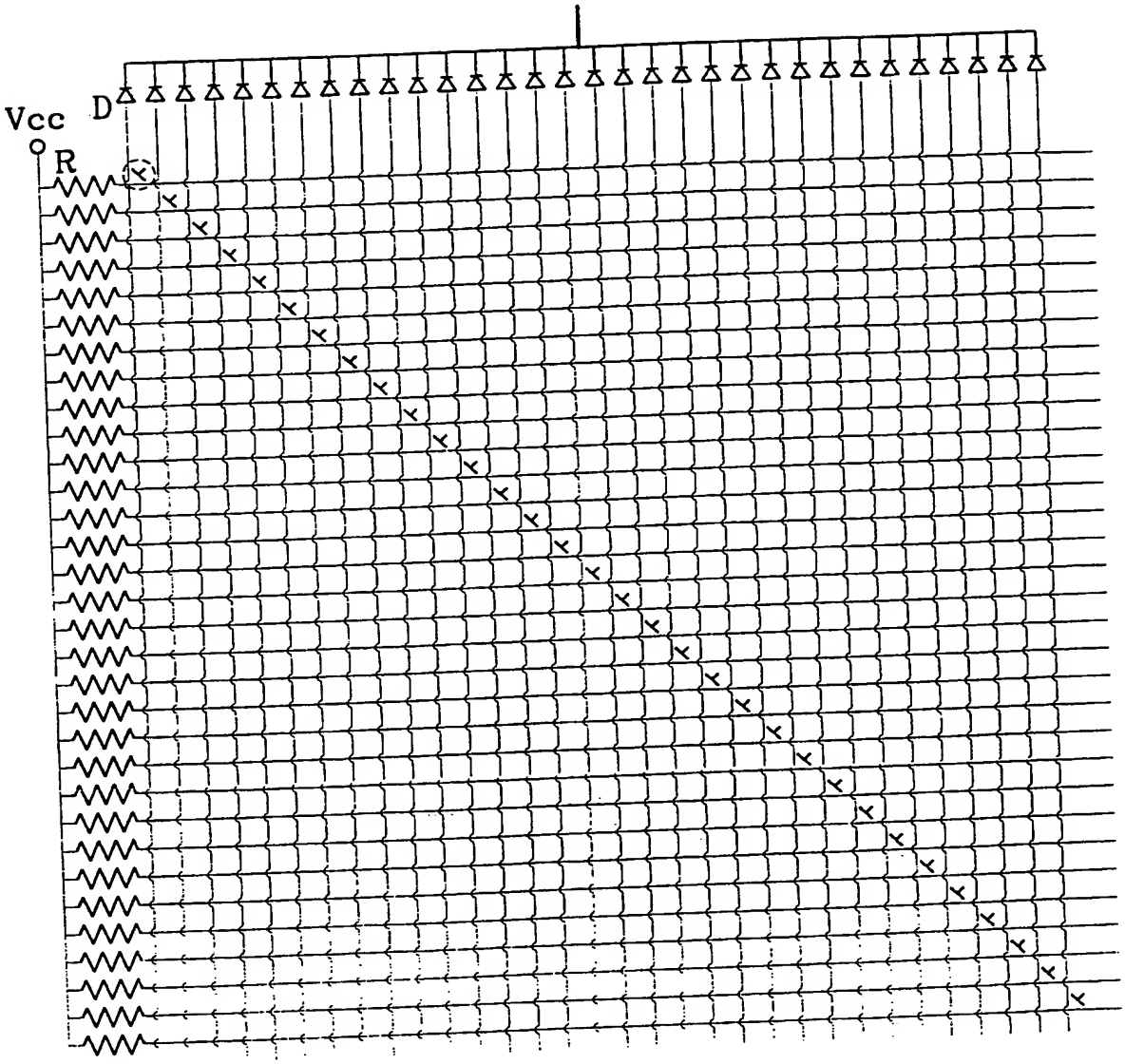


FIG. 4B

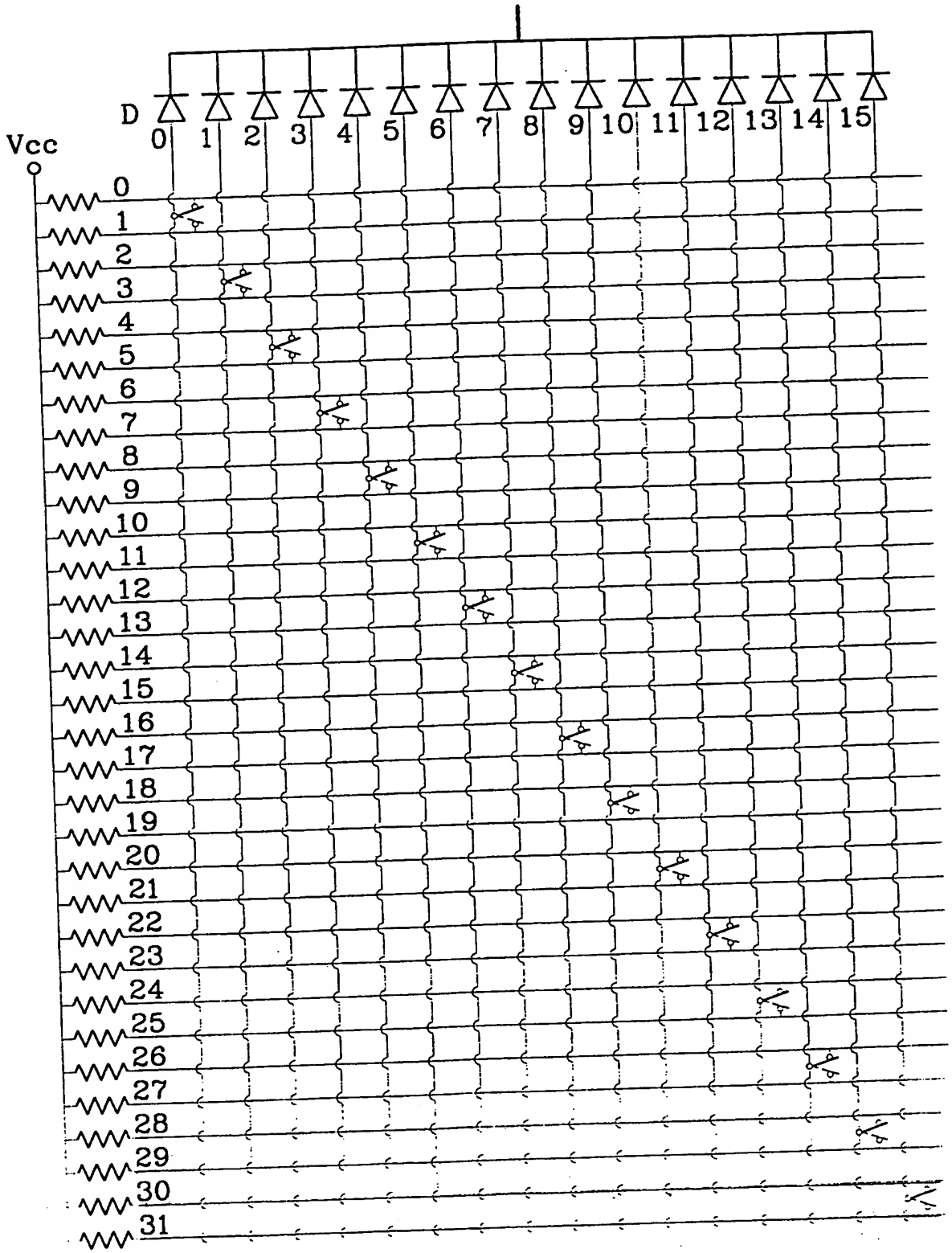

D
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Vcc
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

FIG. 5

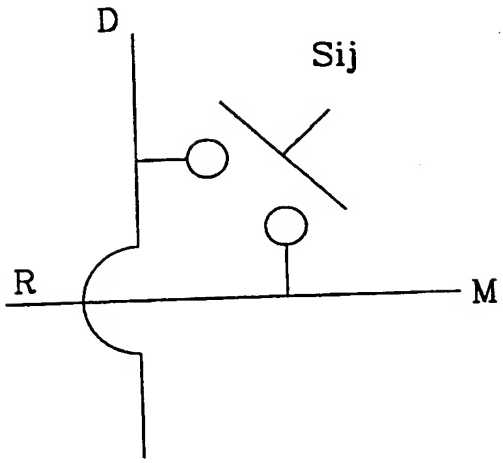
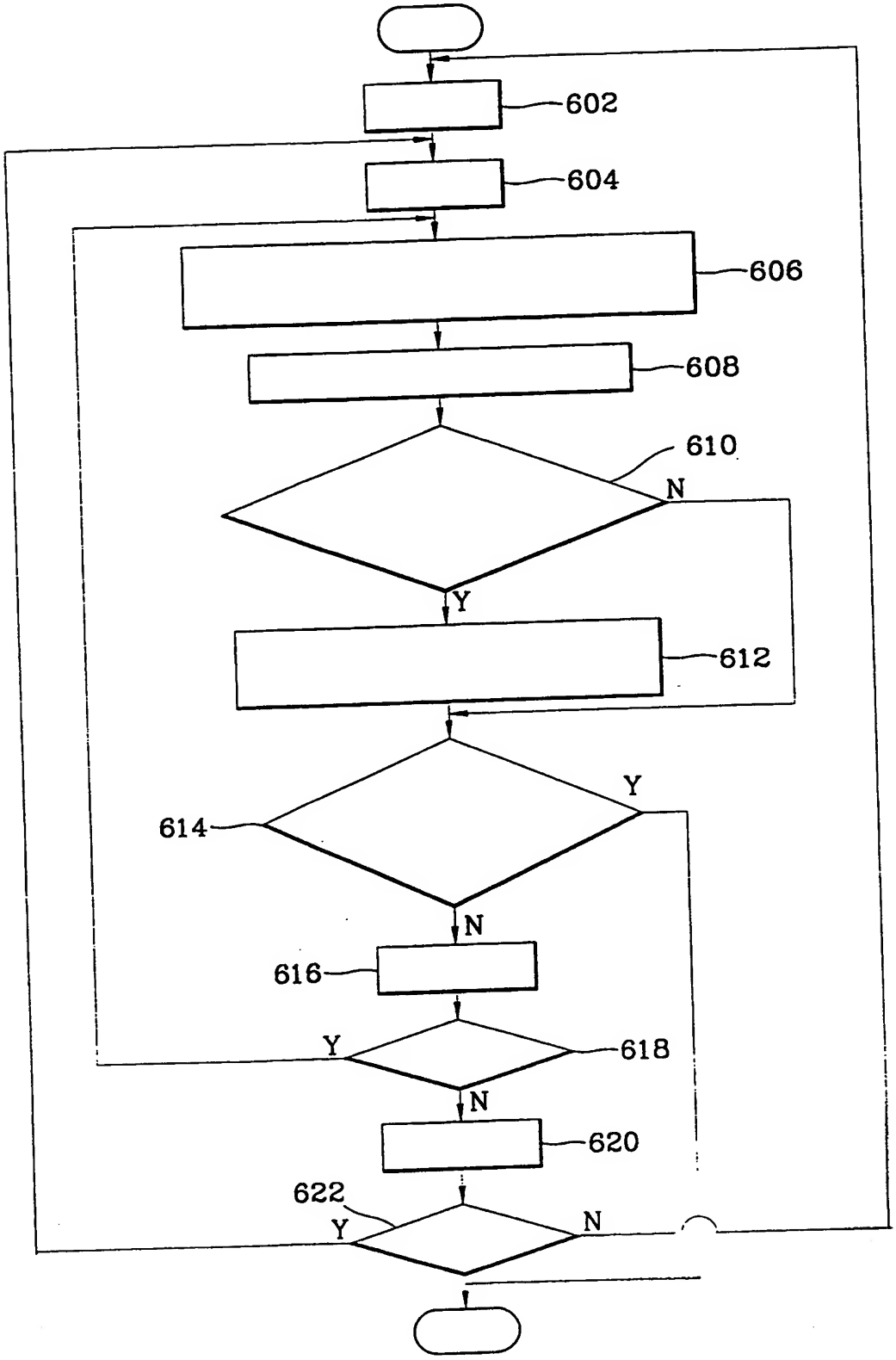


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 99/00574

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7]: G 10 H 7/00; G 10 H 1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: G 10 H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 4736333 A (MEAD et al.), 05 April 1988 (05.04.88), abstract; fig.1.	1 4,5
X	EP 0551884 A2 (YAMAHA), 21 July 1993 (21.07.93), claim 1; fig.1A.	1
X	US 4184400 A (NIIMI), 22 January 1980 (22.01.80), claim 1,20; fig.1.	1
A	US 5262580 A (TANAKA et al.), 16 November 1993 (16.11.93), claim 1; fig.1.	1
A	US 5394784 A (PIERCE et al.), 07 March 1995 (07.03.95), abstract; fig.1.	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
„A" document defining the general state of the art which is not considered to be of particular relevance
„E" earlier application or patent but published on or after the international filing date
„L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
„O" document referring to an oral disclosure, use, exhibition or other means
„P" document published prior to the international filing date but later than the priority date claimed
„T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
„X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
„Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 December 1999 (10.12.99)	16 February 2000 (16.02.00)
Name and mailing adress of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/200	Authorized officer Mihatsek Telephone No. 1/53424/329

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 99/00574

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP A2 551884 EP A3 551884 EP B1 551884	21-07-1993 02-02-1994 20-08-1997	CN A 1074776 CN B 1041659 DE C0 69313147 DE T2 69313147 HK A1 1001932 JP A2 5188946 KR B1 9706171 SG A1 52463 US A 5389729	28-07-1993 13-01-1999 25-09-1997 26-03-1998 17-07-1998 30-07-1993 24-04-1997 28-09-1998 14-02-1995
US A 4184400	22-01-1980	JP A2 53075919 US E 31004	05-07-1978 03-08-1982
US A 4736333	05-04-1988	none	
US A 5262580	16-11-1993	JP A2 5188947	30-07-1993
US A 5394784	07-03-1995	none	